

FIG. 1B

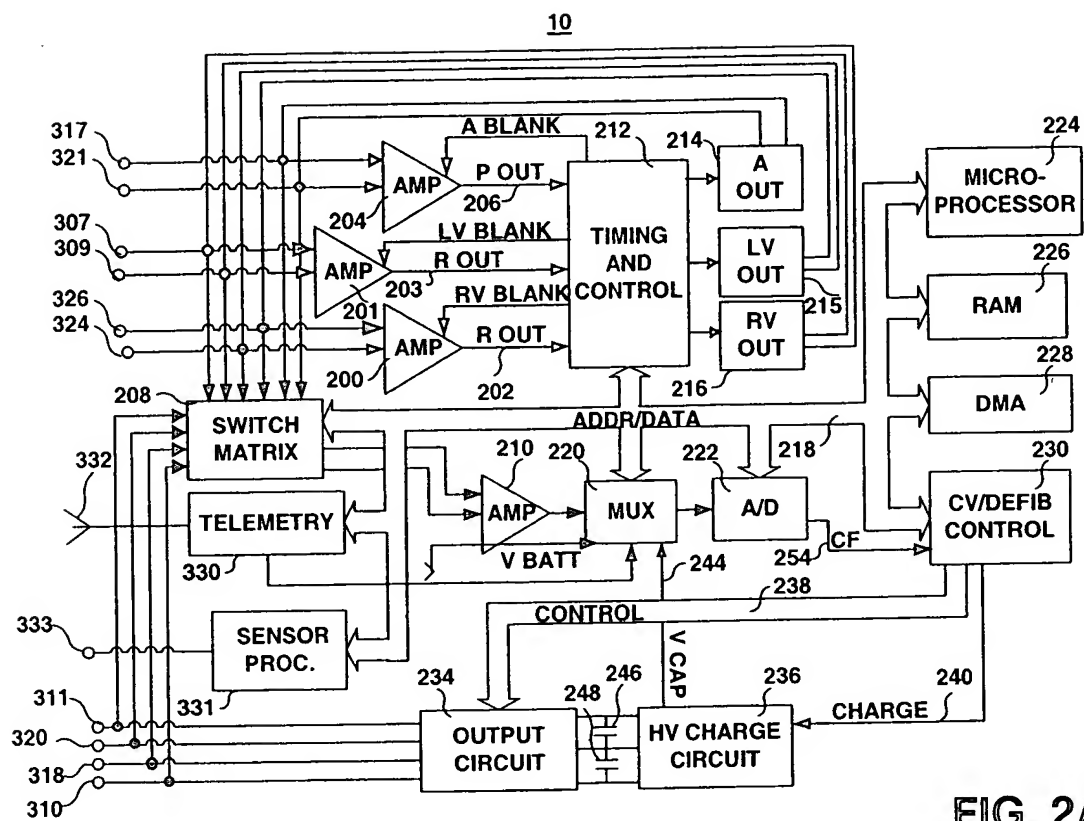


FIG. 2A

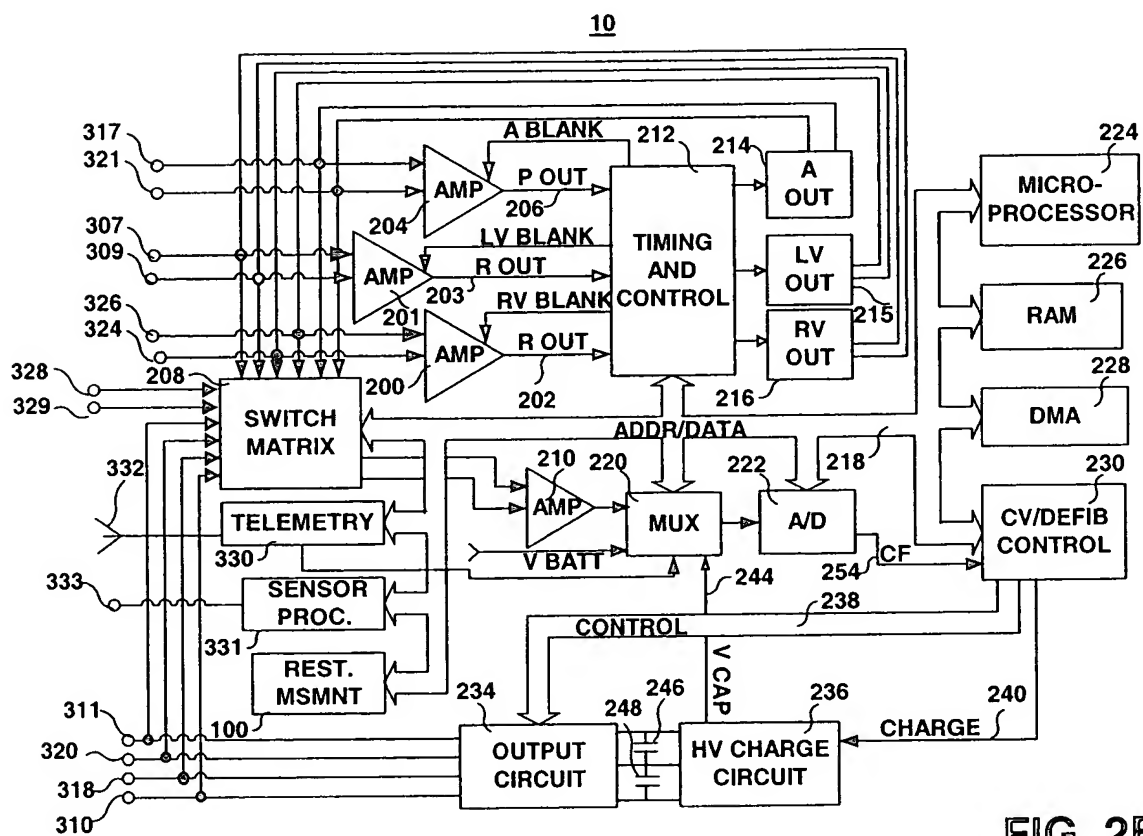


FIG. 2B

FIG. 3

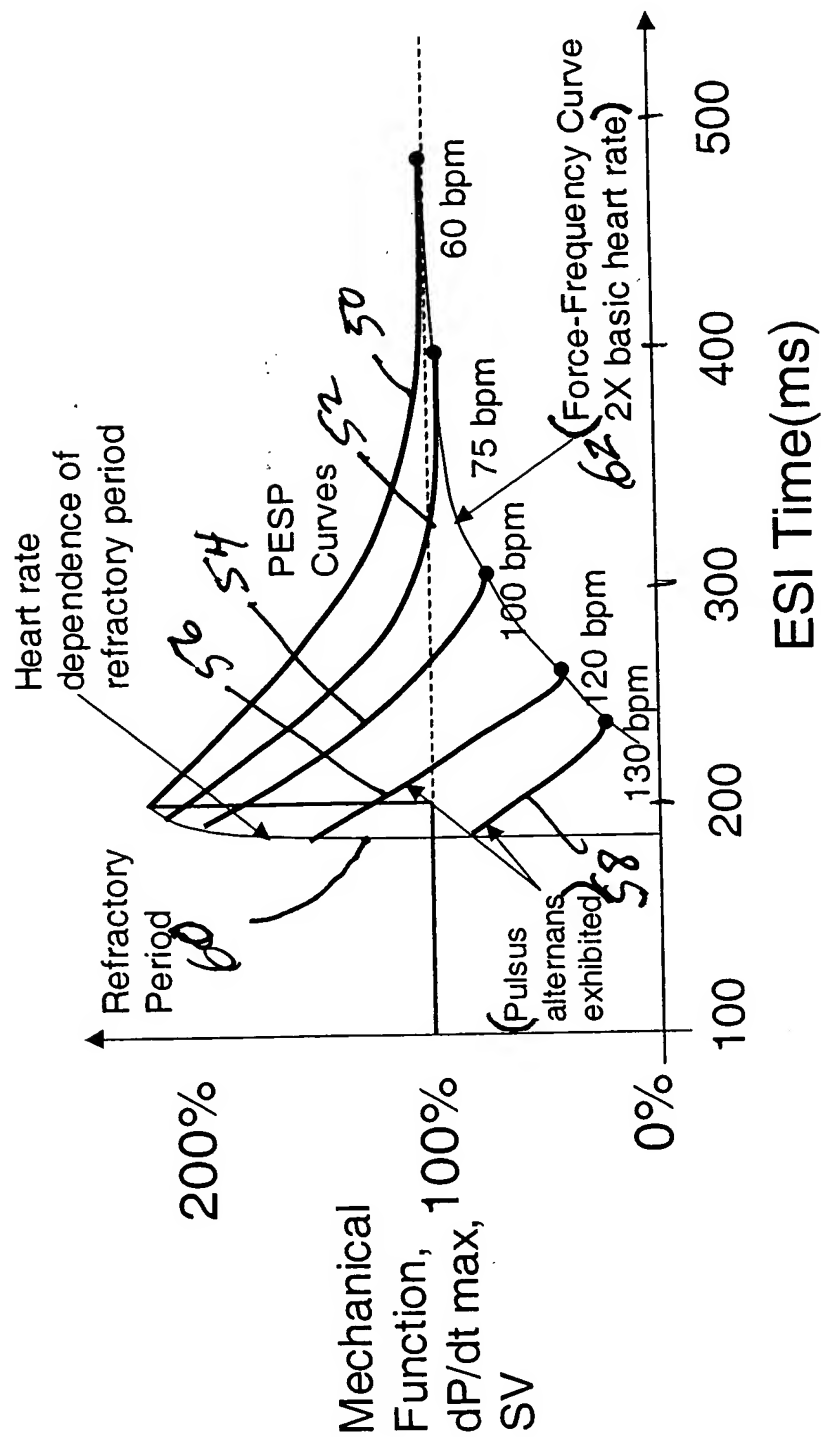
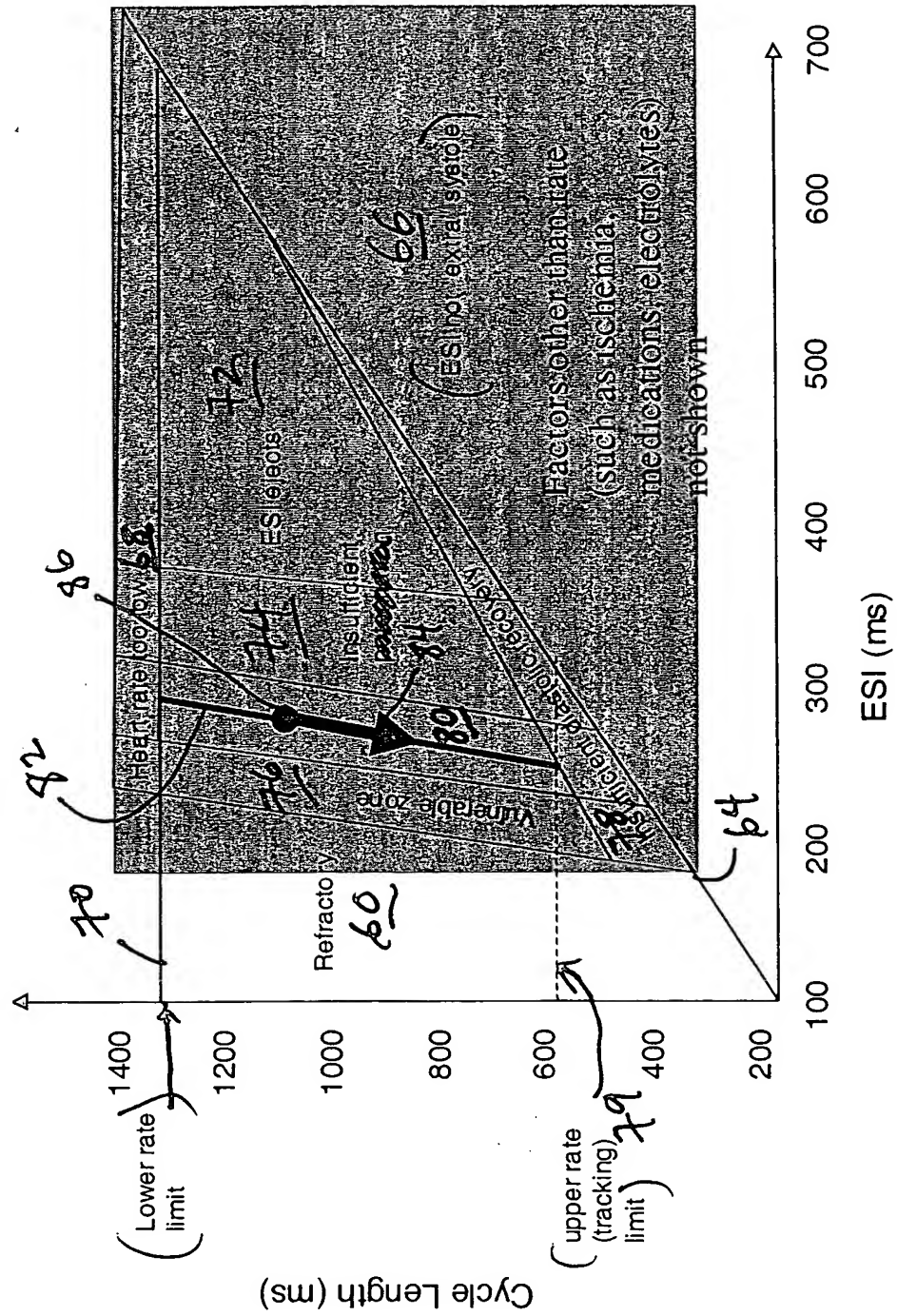


FIG. 4.



Optimal ESI Timing and Heart Rate

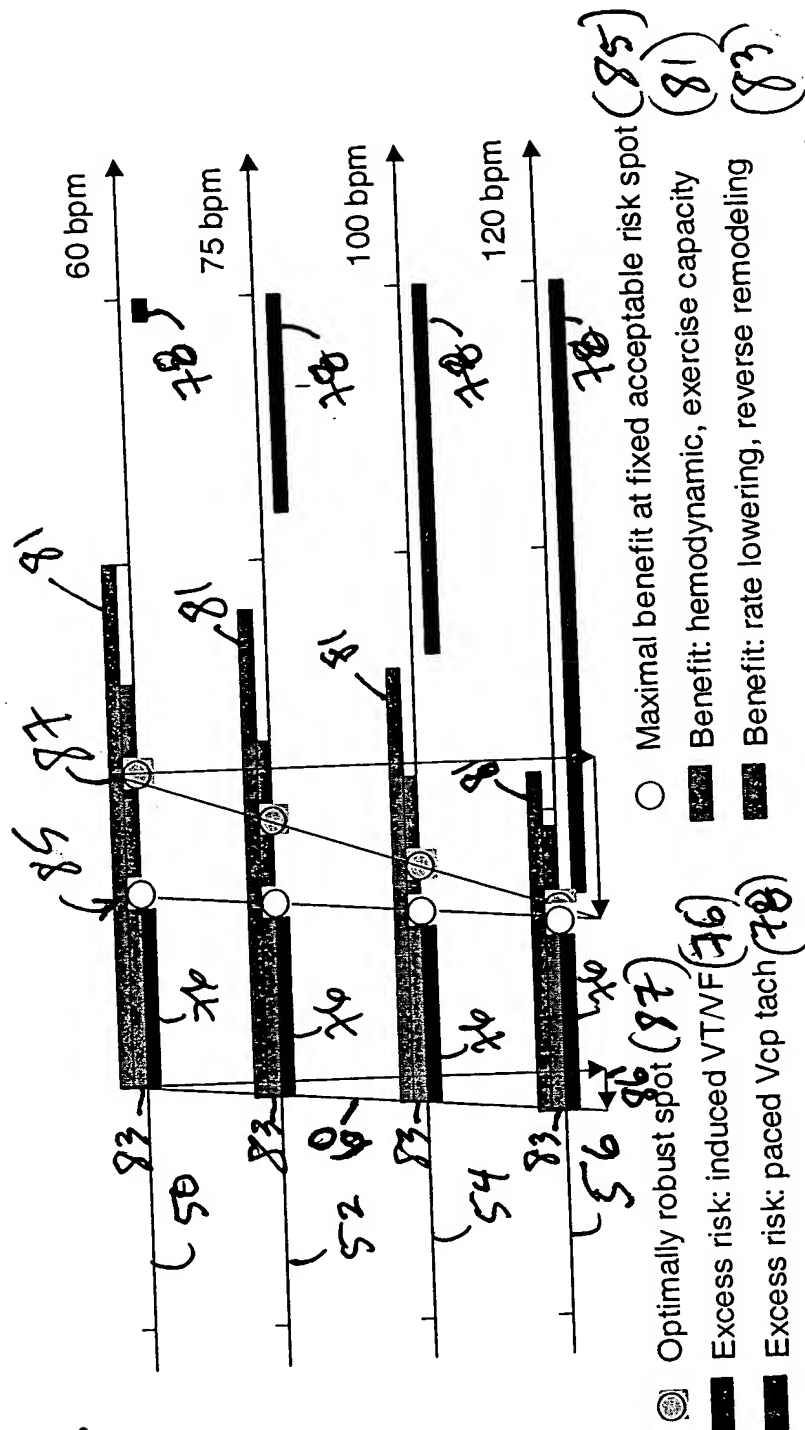
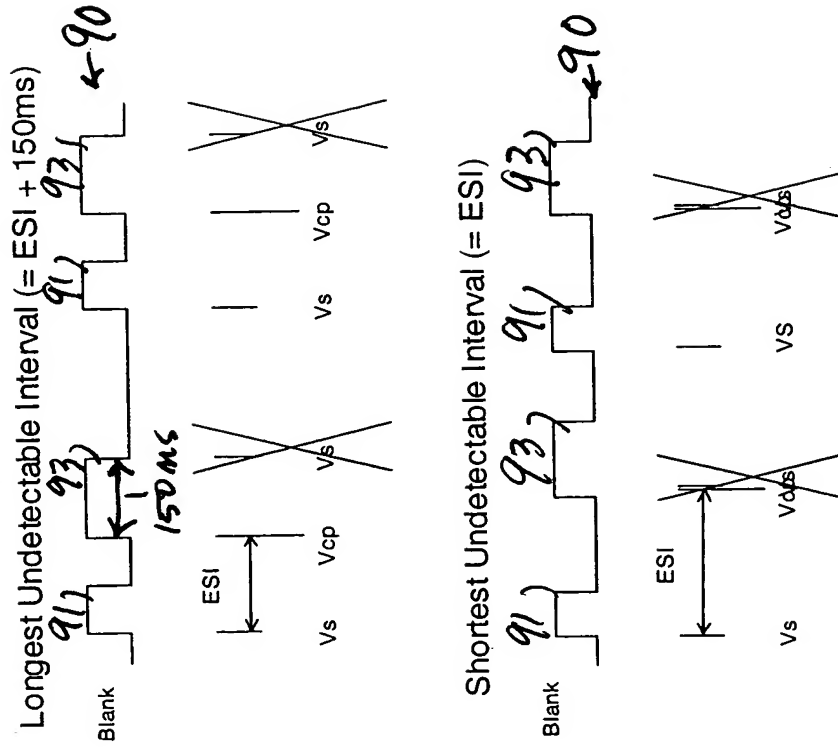


FIG. 5

VT Detection

FIG. 6



Proposed Solutions

- Periodically drop ~~ESS~~
 - Implementation of M of M+1 reveals VT after median delay of M/2 ~~ESS~~ cycles
 - Investigate reducing M at higher rates
 - Consider M = infinity (always on) if rate low enough. (M=0, always off, is already achieved at high rates via ~~ESS~~ rate limit safety rule.)
 - Can speed detection of VTs that are not 2:1 but are close and start with a phase that would otherwise delay their detection
- Suspend ~~ESS~~ upon inappropriate Asense timing
 - Safety rule engages with loss of AV synchrony during most VTs
- Dither timing of A-A or A-V intervals through A or V pacing
 - Occasional variations of 50-100 ms either way (if blanking is short) may be sufficient to enable hidden VT detection
- Auxiliary sensing vector
 - Use Coil-to-Can or other low polarization EGM signals to detect Vsense in blanking window
 - Discriminate by time or morphology from expected CPT evoked response
- Look for rate irregularity as a clue to hidden VT
 - As VT rate enters/leaves undetectable VT zone, CPT rate will abruptly halve/double (perhaps exceeding upper rate limit)
- Reduce blanking/refractory
 - Moves left hand limit to the right (see diagram)
 - Incomplete solution by itself, since Vcp is intended to cause a prompt depolarization which needs to be blanked
 - Perhaps complete solution if implement electronic blanking of known time/morphology evoked R waves but not VTs (see auxiliary sensing vector note)
 - Two fold increase of change of R-R interval at base mechanical rate per change of blanking significantly adds to heart rate range over which VTs can be detected without dropping ~~ESS~~ beats
 - In principle, atrial cross chamber blanking can be made short enough (a few ms) to never hide a VT
 - Could be accomplished with low polarization leads or sense amp electronics modifications.
 - May be combined with auxiliary sensing vector solution
- Deliver ~~ESS~~ with short ESI
 - Enhances window for VT detection (particularly at low ~~ESS~~ rates)
- Keep ~~ESS~~ upper rate limit low
 - Caps aliased VT rates. Upper limit 75 bpm makes all VTs faster than nominal VTDI detectable
 - Exploit in conjunction with reducing blanking and short ESIs (see above) to be least restrictive
 - Use an appropriately lower rate limit if Vpacing and not Vsensing to account for propagation differences

FIG. 8

VT Detection and Operating Range (to 70 bpm)

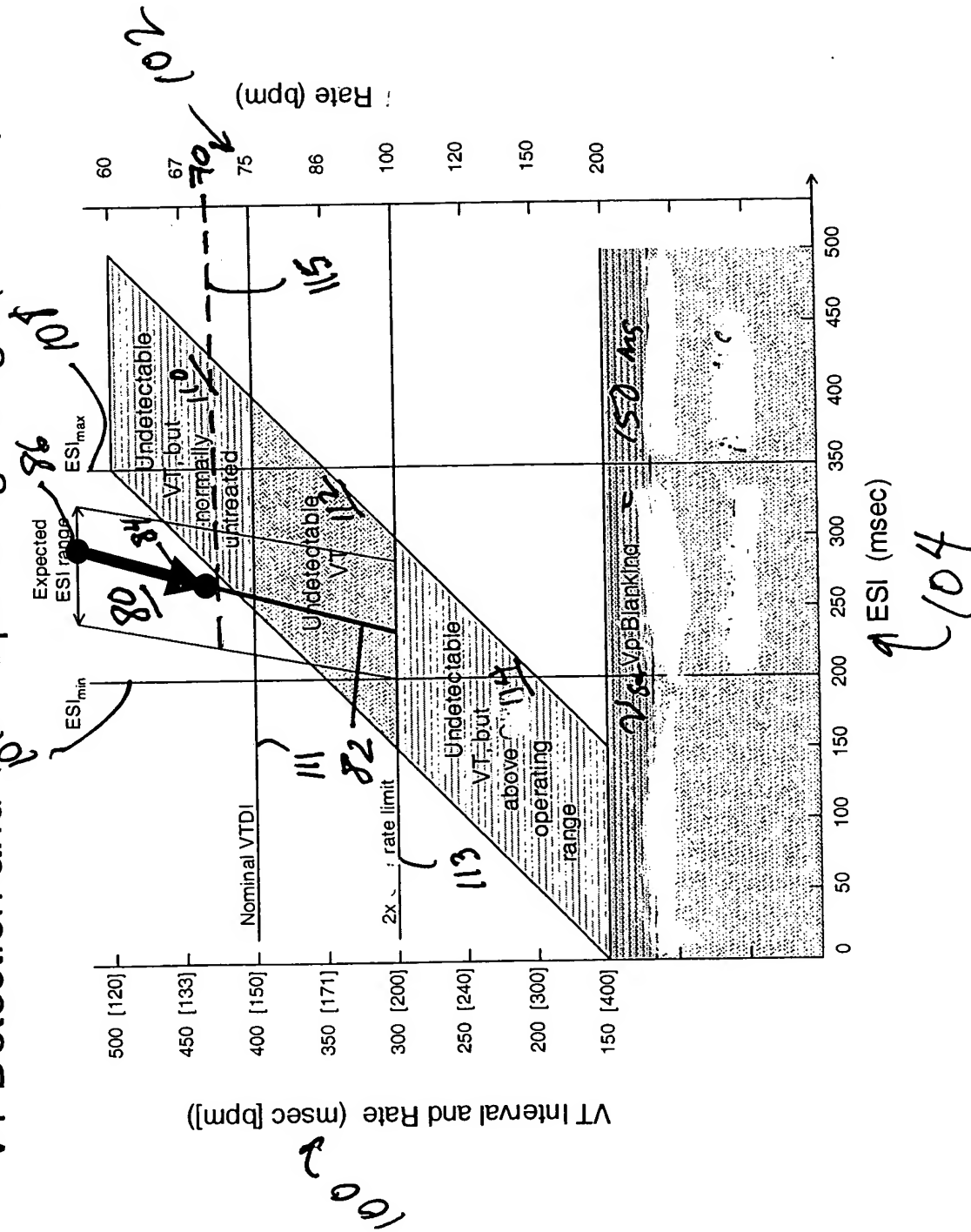


FIG. 9

VT Detection and Extended Operating Range (to 85 bpm with Shorter Blanking)

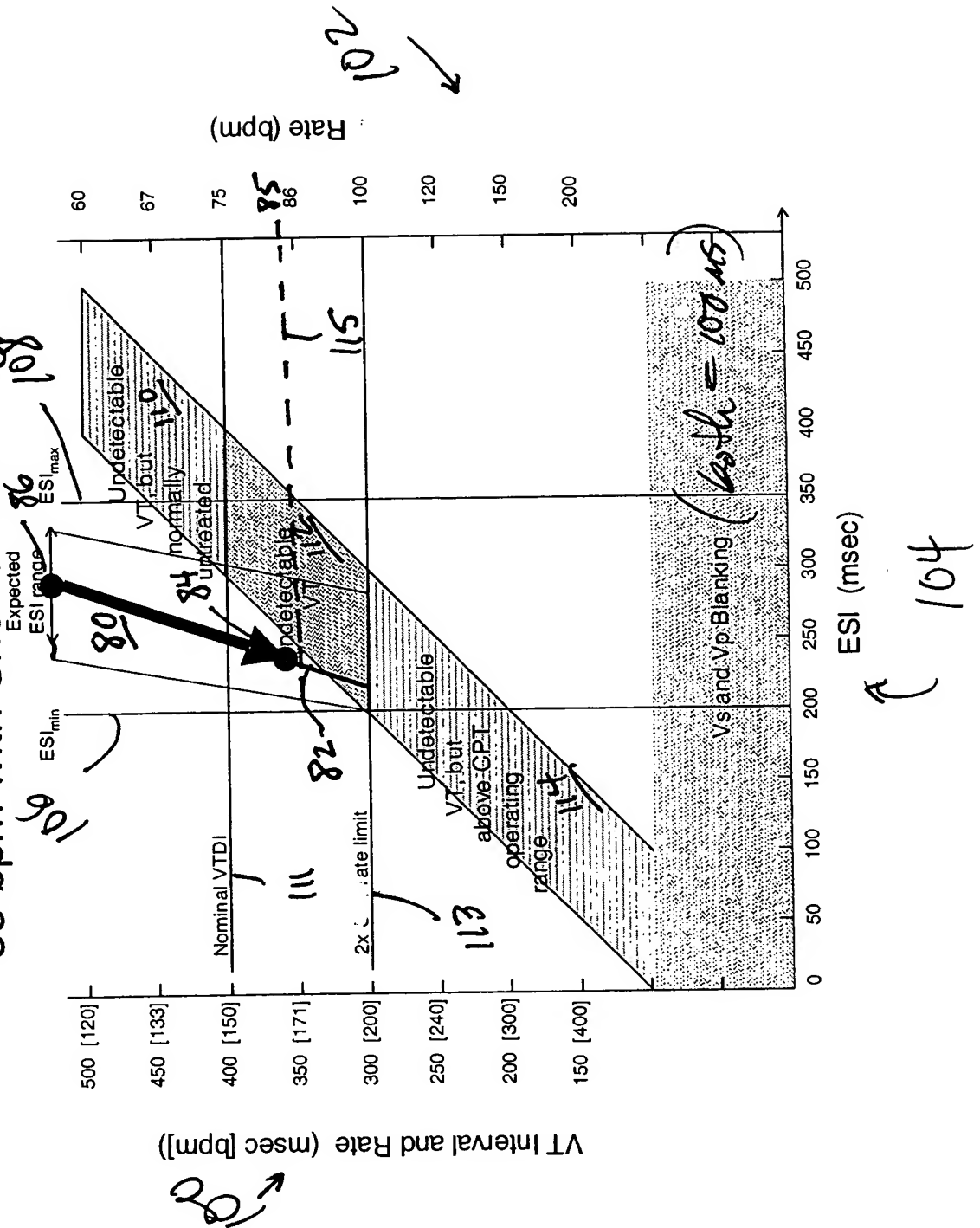


FIG. 10

VT Detection and Further Extended Operating

Range (to 90 bpm)

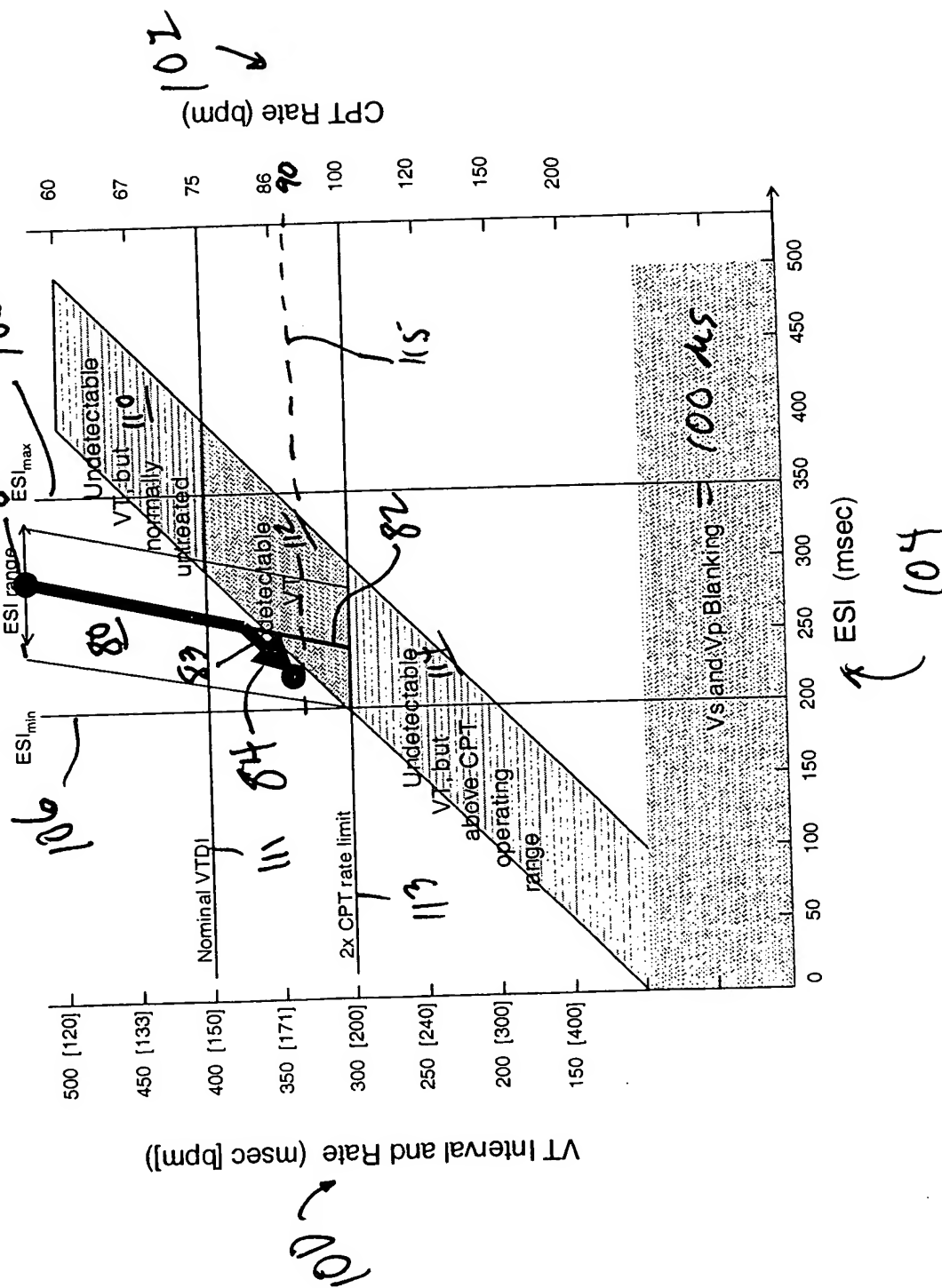


FIG. 11

Transient Override of Rate Limit to Permit Mediated Rate Reduction

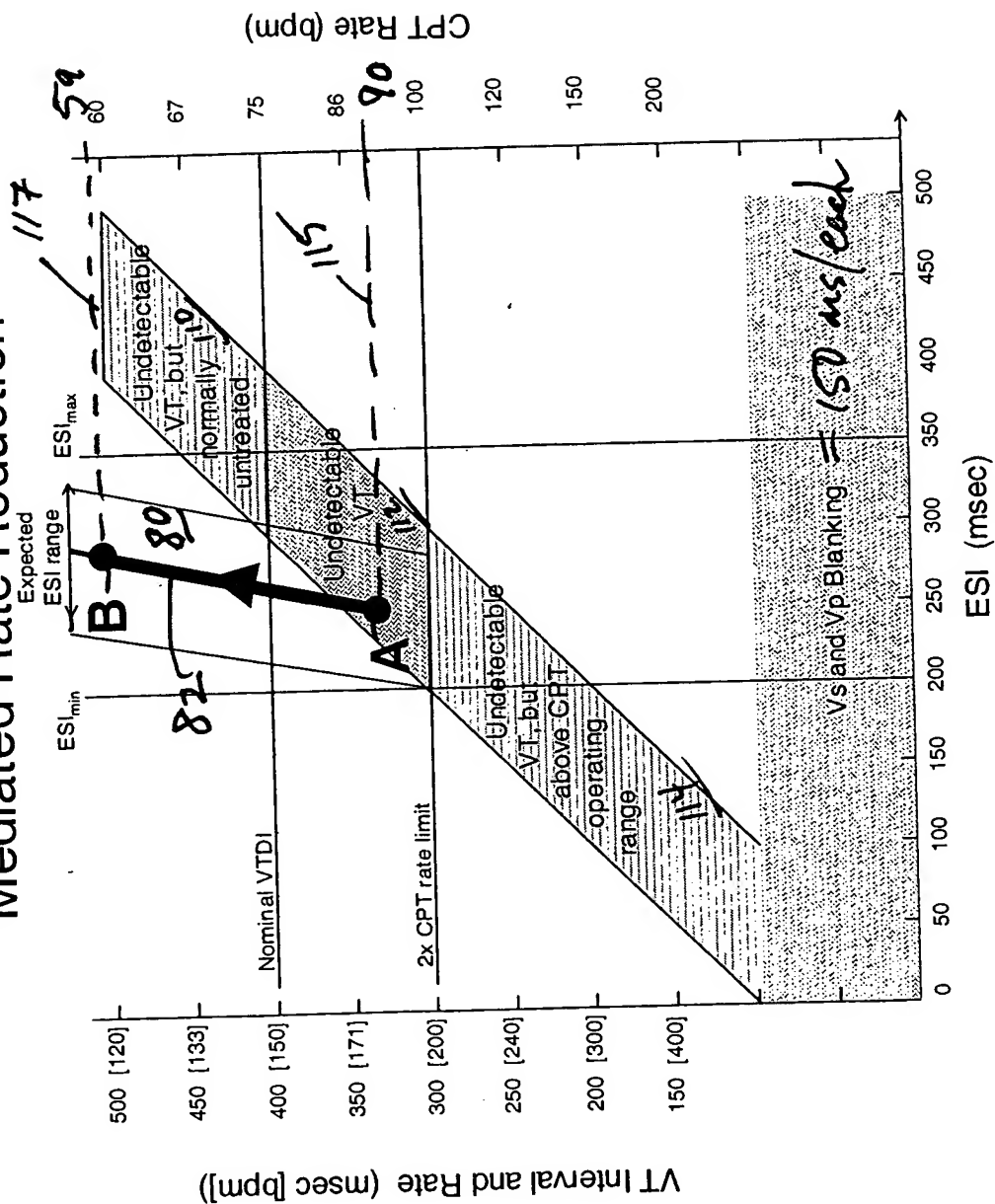


FIG. 12

Vulnerable Zone Risk Mapping

